# CHAPTER 6

# MEDICAL ASPECTS OF CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL DEFENSE

In the *HM 3 & 2* Rate Training Manual you were indoctrinated in the recognition and treatment of chemical, biological, and radiological (CBR) hazards. In this chapter we will discuss the Medical Department's role in meeting the medical aspects of CBR defense, which includes protection from CBR hazards, mass casualty decontamination, decontamination stations, and supplies for decontamination.

## CHEMICAL DEFENSE

To appreciate the importance of defense against chemical agents, one only has to study the disastrous experience of unprepared and improperly indoctrinated troops in World War I. The importance of planning and training for defense against chemical agents cannot be underestimated.

Chemical agents may be dispersed by modern weapons for strategic as well as tactical purposes; the areas of their employment are limited by the range of the weapons or aircraft used by the combatant force. The chances of surviving a chemical attack are increased as knowledge of the nature of the agents and of the use of correct protective measures is increased.

A naval unit afloat finds itself in a unique situation insofar as defending against toxic chemical agents is concerned. Because agents can be released as clouds of vapor or aerosol, they can envelop the exterior of a vessel and may penetrate within the hull due to the extensive use of artificial ventilation aboard ship. Therefore, extensive contamination may result from such an attack. As the ship, in most cases, cannot be abandoned, it must be decontaminated while the personnel manning it continue to eat, sleep, live, and fight on board.

The medical officer or the hospital corpsman on independent duty must organize the Medical Department to meet the medical needs of defense against chemical agents well in advance of actual need. All hands must be indoctrinated in the use of protective equipment and self-aid procedures. Close liaison and planning must be maintained with damage control personnel responsible for area decontamination, and all medical personnel must be informed of the approved methods currently available for treatment of casualties resulting from the use of chemical agents.

## SELF-PROTECTION AND TREATMENT

In a chemical attack, the first priority is to ensure your own survival so that you may then treat casualties. There are several items available to help you survive a chemical attack, and you should know how to use them. Along with protective clothing, they include a protective mask, which should be put on at the first indication of a chemical attack. The mask will filter out all known chemical agents from the air and allow you to work in a chemically contaminated area. In addition, there is the M258 personal decontamination kit, which is to be used to chemically neutralize any toxic chemical agent you may have on your clothing or skin. Finally, there are two types of antidote autoinjectors, atropine and 2-PAM C1, for your own use if you become a nerve agent casualty. Familiarize yourself with your equipment. Know how it works when you need it.

## DECONTAMINATION

The guiding principle in personnel decontamination is to avoid spreading contamination to clean areas and to manage casualties without aggravating other injuries.

It will frequently be necessary to decide whether to handle the surgical condition or the chemical hazard first. If the situation and the condition of the casualty permit, decontamination should be carried out first, for the longer the chemical remains on the body the more severe

will be the danger of spreading the chemical to other personnel and equipment.

In general, the following order of priority for first aid and decontaminating casualties is recommended:

1. Control of massive hemorrhage
2. First aid for life-threatening shock and wounds
3. Decontamination of exposed skin and eyes
4. Removal of contaminated clothing and decontamination of body surfaces if not in a toxic environment
5. Adjustment of patient's mask, if a mask is necessary
6. First aid for less severe shock and wounds

The basic plan for sorting and handling casualties is indicated in figure 6-1. This plan should be modified to fit specific needs. In general, the decontamination station, or "dirty" area, receives casualties contaminated with a chemical agent. The arrangement of this area will vary with the site of the medical unit and the facilities available for decontamination.

All ships of the force will have at least two decontamination stations, insofar as the hull design permits. The "dirty" areas should be topside or in some well-ventilated space. Personnel manning these areas should be provided with protective equipment.

In the "dirty" area casualties will be decontaminated, undressed, showered, and passed along to clean areas. Both areas should be clearly

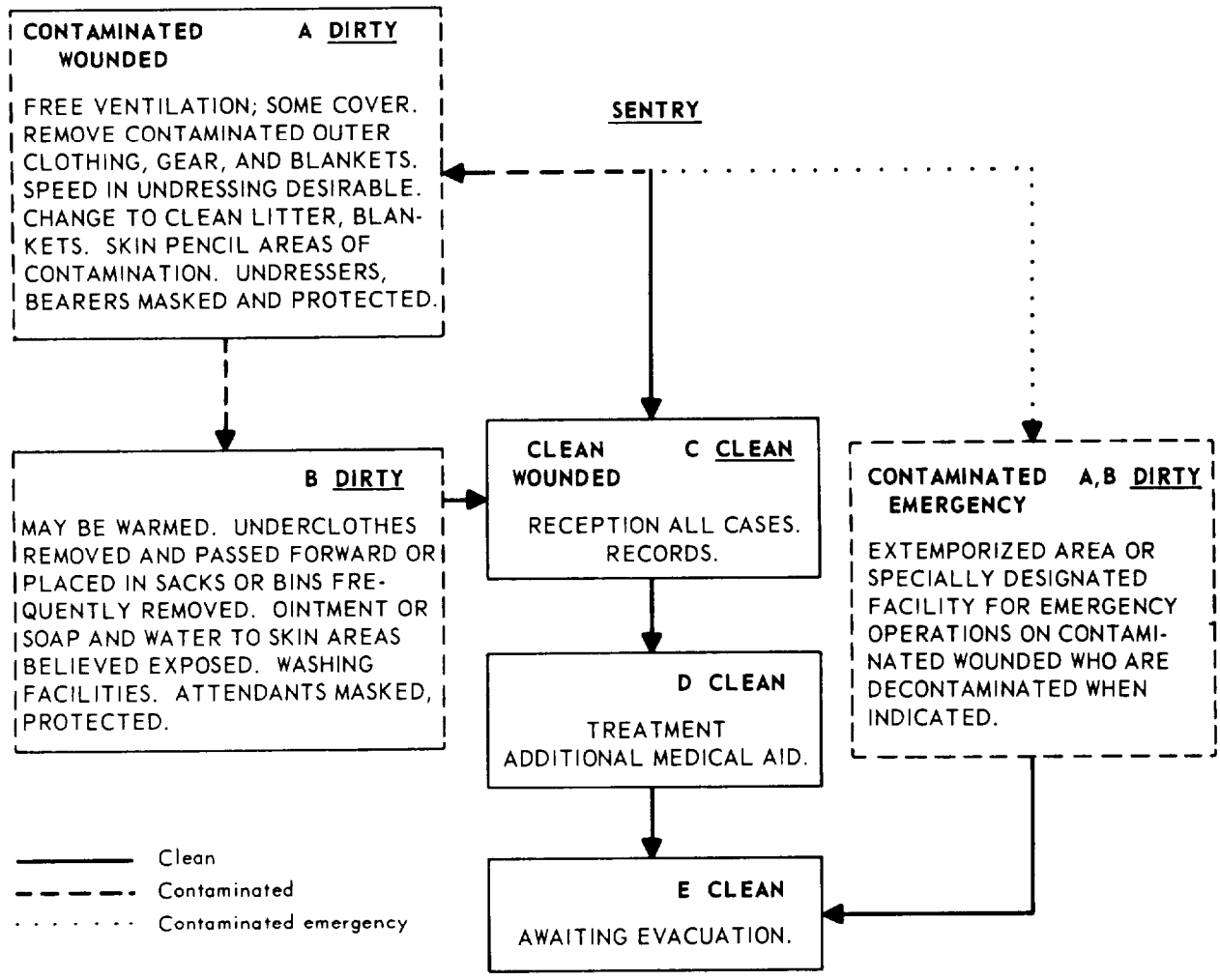


**Figure 6-1.-Basic Plan for Sorting and Handling Casualties.**

marked "clean" or "contaminated." Decontamination kits, protective ointment, and an abundant supply of soap and water must be provided. In addition, standard first-aid items should be on hand. It will be extremely helpful if small trestles, boxes, or similar supports are improvised so that stretchers may be placed on them and thus be raised off the deck.

Personnel handling contaminated cases must avoid spreading contamination to other personnel and to spaces not set aside as areas of reception of contaminated cases. Contaminated personnel, clothing, or equipment must be kept out of uncontaminated areas. The subsequent decontamination of such spaces is quite difficult and must be avoided. Contaminated clothing and gear must be placed in designated dump areas and, insofar as practical, must be kept in metal cans with tightly fitting covers.

## SUPPLIES

The medical officer or Medical Department representative is responsible for maintaining adequate supplies for the decontamination and treatment of CBR casualties.

Medical decontamination supplies are supplied to ships of the force on a personnel strength basis as listed in current AMALs.

The cabinets will be kept locked, and the keys will be in custody of the damage control assistant during emergency conditions. Cabinets and chests will be stenciled with a red cross and marked "DECONTAMINATION MEDICAL SUPPLIES."

The quantities of specific drugs that commands and activities are required to maintain for defense against chemical and biological warfare are given in NAVMEDCOMINST 6710.3.

# BIOLOGICAL DEFENSE

Epidemics arising from natural causes have plagued military forces for centuries and in many instances have determined the outcome of campaigns. In the past, recognition of this drain on personnel undoubtedly has led to attempts to produce illness in epidemic proportions through pollution of water and food supplies as well as through other means, but the dissemination of disease-producing organisms has never been employed on any significant scale as a weapon of war.

Since World War II, due to the general advancement of knowledge in the various fields of biological sciences and as a result of known research in many countries on the use of microorganisms as a weapon of war, biological warfare has become a very real possibility.

In the hands of an unscrupulous enemy, antianimal and antiplant agents could be powerful instruments of war, reducing or destroying a nation's food supply. This chapter, however, is concerned only with agents that would be effective against populations, and although their effectiveness has never been established by actual use in war, they are considered to have grave military capabilities.

Biological warfare has certain aspects in common with chemical warfare in that biological agents may be dispersed in the air and may travel downwind in the same manner as a gas cloud. These agents may be inhaled unless a protective mask is worn and may cause disability or death. They are capable of contaminating clothing, equipment, food, and water supplies. Some types of agents may persist in the target area for considerable periods of time.

Biological agents, unlike most war gases, cannot be detected by the physical senses or by chemical detectors, and their presence or identity can be determined only by laboratory examination of air samples or contaminated objects. The time lag between exposure and the onset of disease symptoms will usually be a matter of days, rather than hours, as is the case with most chemical agents. All persons will not be similarly affected even though exposed to the same dosage of biological agents. Some may escape disease entirely, some may have a very mild attack, and some may become seriously ill.

## INDIVIDUAL PROTECTION

As in the case of exposure to most communicable diseases, the natural resistance of the body and the maintenance of the body in the best possible physical condition constitute important lines of defense against biological agents. However, immunity and states of good health cannot be expected to triumph over massive onslaughts of biological agents that may have been tailored to create varying degrees of incapacitation including death. To reduce the effectiveness of such attacks, protective equipment has been provided and defensive measures have been delineated to protect the individual.

In general, these measures closely parallel those provided for defense against chemical attack.

Since the inhalation of airborne organisms is considered to be the greatest potential hazard in biological warfare, the protective mask is an important component of defensive equipment. A mask that is in good condition and has been properly fitted will greatly reduce the possibility of inhaling infectious material in the air. Since the individual cannot detect the presence of biological agents, the use of the mask and other protective equipment will depend upon early warning.

To produce disease, biological agents must gain entrance into the body. A concentration of biological agents on the skin might, in time, be transferred to a portal of entry. Any type of clothing will provide some protection by reducing the quantity of agents coming in contact with the skin. The degree of protection afforded is dependent upon how well the fabric stops penetration and the number of layers of clothing being worn. Since this protective effect is due to the mechanical filtering or screening action of the cloth, it is important that shirt and jacket collars be fastened, sleeves rolled down and cuffs buttoned, trouser cuffs stuffed inside tops of boots or socks, and all other garment openings tied or otherwise secured to minimize the entry of airborne organisms and to reduce the risk of bodily contact with biological agents that may be present on the surface of the ground or in the air.

Military headgear helps safeguard the hair from heavy contamination, and ordinary gloves or mittens provide protection for the hands. The impregnated type of clothing issued for protection against chemical agents provides a higher degree of protection than the ordinary uniform, and whenever it is available it should be used.

Upon notification of an attack with biological agents, or before entering an area known to be contaminated by them, the individual will:

- Put on protective mask and check it for correct fit.
- Button clothing. Tie clothing at wrists and ankles with string or extra shoelaces. Put on special protective clothing, if available.
- Put on gloves, if available.
- While in the contaminated area, maintain the provisions outlined above.
- Upon leaving the area, proceed with decontamination measures to the extent the situation permits.

## GROUP PROTECTION

In biological as well as in chemical and radiological warfare, a tightly constructed shelter offers great protection. The shelter must be pressurized to prevent entrance of the microorganisms, which is accomplished by introducing filtered air into the shelter. If the shelter is reasonably tight, this incoming air will cause any flow of air to be outward. Any building, shelter, or field fortification without this feature provides only limited protection from aerosols. Eventually microorganisms will penetrate through cracks and will constitute a respiratory hazard unless the protective mask is worn. Again, utilization of shelters will depend upon early warning.

## PROTECTION OF FOOD AND WATER

Food and water supplies are especially susceptible to deliberate contamination. Civilian supplies all too frequently do not receive careful supervision and protection and must always be suspected of accidental or deliberate contamination. It should also be emphasized that water is not necessarily pure just because it comes from a faucet. In some countries pure water is the exception rather than the rule. The safest rule is to consume only foods and drinks received from military sources. Procedures for protection of the water supply and routines for inspection and decontamination are well defined in the military and, if diligently observed, will protect from deliberate contamination.

### Water

Chlorination is by far the almost universal method of purifying water, and it destroys most of the biological agents. Boiling maybe required to ensure proper decontamination in exceptional cases.

The military establishes water points in the field whenever possible. The equipment location at these points provides for filtration as well as chlorination and, when properly operated, is effective in removing organisms that produce disease. Some biological agents cannot be destroyed by normal water purification techniques. When biological agents are known to have been used, all drinking water must be boiled. In

the preparation of water for large numbers, the boiling procedure should be supervised. Water boiling may, of necessity, become an individual responsibility and may be so directed.

For small groups of people, the Lyster bag is provided as a suitable container for the storage of water that has already been treated for use in the purification process. Water that has not been made potable previously is purified in the Lyster bag by means of chemicals. Water purification procedures are discussed in detail in chapter 11 of the *HM 3 & 2* Rate Training Manual.

### Food

In the event of a known or suspected biological attack, all exposed or unpackaged foods not in critical supply should be destroyed. In most instances, food can be rendered safe for consumption by application of moist-heat cooking procedures. In some instances, deep fat cooking is adequate. Some foods, however, cannot be sterilized because the treatment would render them unacceptable for consumption.

## DECONTAMINATION

The extent to which personal decontamination can be carried out following actual or suspected exposure to biological agents will depend upon the existing tactical situation and the facilities available. If the situation permits, contaminated clothing should be carefully removed and the body washed thoroughly with soap and water before donning fresh clothing. Specific attention should be given to decontamination and the treatment of skin lesions.

Normally, each individual is responsible for his or her own decontamination. If a person is physically unable to decontaminate himself or herself, this process has to be performed by other available personnel, including medical personnel. Since illness resulting from exposure to biological warfare may be delayed because of the incubation period, decontamination may occur before the individual becomes ill. Decontamination of the wounded, however, will not have been carried out and is the responsibility of Medical Department personnel. In the management of the wounded, a problem of priority may exist. When the situation and the condition of the casualty permit, decontamination should come first. However, massive hemorrhage, asphyxia, or other life-endangering conditions naturally receive priority.

In general, all candidates for decontamination should first have all exposed areas thoroughly washed with soap and large amounts of water, the mask adjusted, and all contaminated clothing removed. The casualty may then be moved to a clean area where the wounds can be treated.

Decontamination procedures are the same as those used for casualties of chemical warfare.

## RADIOLOGICAL DEFENSE

Teams entering contaminated areas to remove casualties and those working in decontamination stations have two major concerns. One is the prevention of their own contamination and the other is preventing or reducing radioactive exposure. Contamination can be avoided by decontaminating patients and equipment prior to handling, wearing appropriate protective clothing and equipment, avoiding highly contaminated areas, and strictly observing personal decontamination procedures. Exposure to radiation should also be avoided or minimized. Alpha and beta particles and gamma rays are emitted from radioactive contaminants and present a direct risk to the health and safety of personnel in the contaminated area. This risk can be avoided or minimized by following some simple guidelines and using common sense. Time, distance, and shielding are the major principles that guide actions to avoid exposure.

Radioactive decay and the deposition of fallout products progresses rapidly in the early hours after a nuclear blast, and the hazards to rescue workers can be reduced considerably if operations can be delayed until natural decay has reduced the level of radioactivity. If teams trained in the use of survey instruments are available, guesswork can be eliminated since they will determine the intensity of radiation with their instruments and mark perimeters of danger zones.

Limiting the time of exposure is essential if total avoidance is not possible. Rotating personnel entering an exposure risk area, planning actions to minimize time in the area, and prompt decontamination reduce the total time the individual is exposed and therefore reduces the dose of radiation absorbed by the body.

Both radioactive particles and electromagnetic waves (gamma rays) lose energy and consequently lose their ability to harm tissue as they travel away from their source. Therefore, the further one is from the source, the danger of an exposure is minimized.

Shielding is an essential component in preventing radiation exposure. Alpha and beta particles have very little penetrating power and the intact skin forms an adequate barrier in most cases. Most particle exposure is the result of inhalation or ingestion, although radiation particles may enter the body through burned, abraded or lacerated skin. In avoiding particle exposure, full personnel protective clothing and a protective mask with hood provides the best protection. The protective mask and foul weather gear will provide lesser but adequate protection. In cases where no protective breathing devices are available, some protection is afforded by breathing through a folded towel, handkerchief, or several surgical masks. Avoid hand-to-mouth contact, eating, or smoking in contaminated areas.

Gamma radiation has much greater penetrating power and presents the greatest risk of exposure and damage to tissue. Although lead is the most effective shielding material, wood, concrete, other metals, and heavy clothing will somewhat reduce the amount of gamma radiation that reaches the body.

## DECONTAMINATION STATIONS

In a large-scale nuclear catastrophe there may be innumerable casualties suffering not only from mechanical injuries and thermal burns, but from radiation injuries and psychological reactions as well. One of the first problems will be to organize an efficient sorting system. The medical facility should consist of a personnel monitoring station, a clean and a contaminated emergency treatment station, a decontamination station, a sorting station, and various treatment stations. An ideal medical facility design is shown in figure 6-2. It should be set up so that personnel must pass through a monitoring station prior to sorting for medical care. If there is a need for decontamination, the casualty should be routed through the decontamination station on the way to the sorting station. If possible, the physical layout should be arranged so that no casualty can bypass the monitoring station and go directly to a treatment station. Also, casualties who are contaminated should be unable to enter clean areas without first passing through a decontamination station.

Patients brought in by the rescue teams or arriving on their own should first proceed

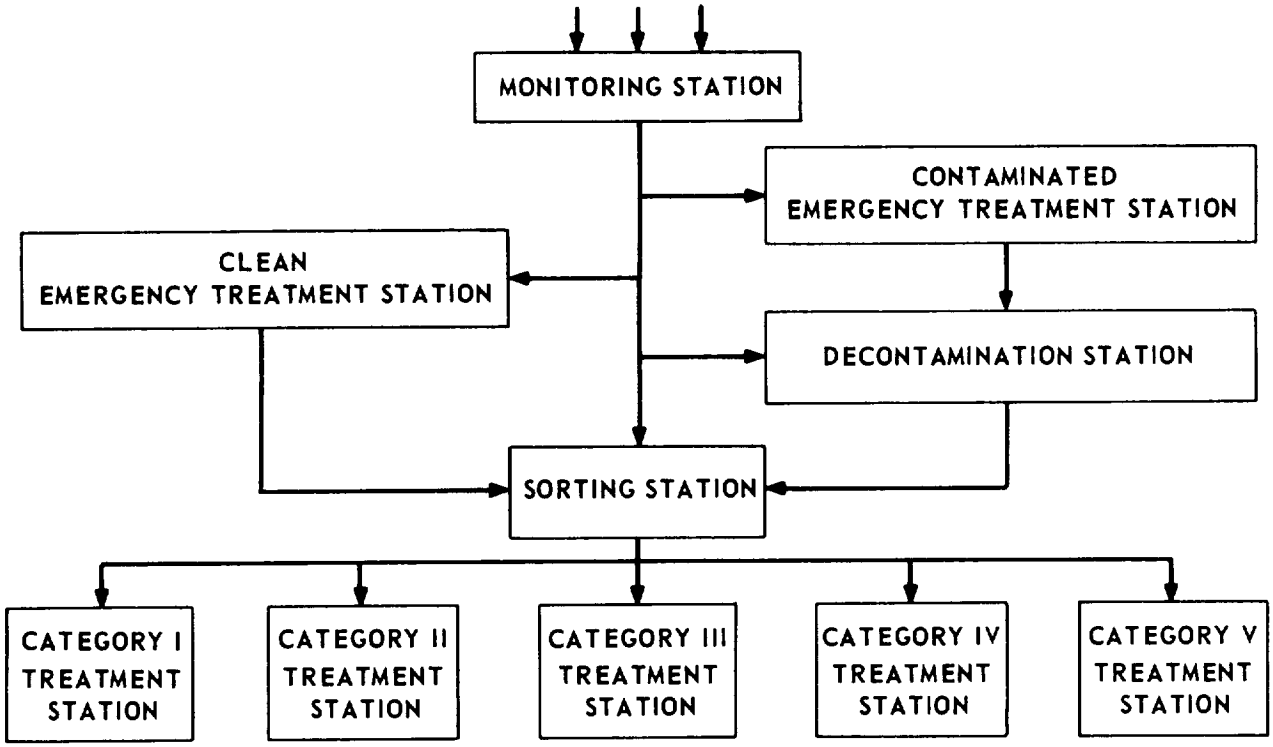


**Figure 6-2.-Patient Flow Pattern and Medical Treatment Facility.**

through the monitoring station to determine whether or not they are contaminated with radioactive material. No medical treatment should be instituted in the monitoring station.

Generally speaking, only personnel who have had training and experience as members of Radiological Safety and Radiological Decontamination teams or as members of Damage Control parties should be assigned to the monitoring station. However, those operating the monitoring station should have a basic knowledge of and experience with radiac instruments. In this way, individuals can be used in either capacity should the need arise.

After the patients are monitored, they are directed or taken down one of four avenues, depending upon their physical conditions. Those requiring immediate lifesaving measures should be assumed to be contaminated and routed directly through the monitoring station to the contaminated emergency treatment station. Definitive monitoring for these individuals may be performed at the decontamination station. Both treatment stations are set up much the same and should have only those facilities necessary for immediate lifesaving forms of treatment. Personnel working in these stations should be better versed in emergency first-aid care than those used for monitoring and for rescue teams, and they need not be trained in radiation monitoring.

After emergency lifesaving procedures have been attended to, casualties from the clean emergency treatment station should be taken directly to the sorting station, and those from the contaminated treatment station should be taken to the decent amination station.

Casualties not requiring immediate emergency treatment should be taken or sent from the monitoring station directly to the sorting station or to the decent amination station, whichever is appropriate. The decontamination station should be set up to take, hold, and dispose of all contaminated clothing and to supply clean replacement clothing after the casualty has been decontaminated. It will also require monitoring equipment, showering and washing facilities, and some capability for surgical (e.g., wound) decontamination when necessary.

Of the personnel available to the treatment facility, several of those most experienced and knowledgeable in radiological safety and radiation protection should be assigned supervisory jobs in the decontamination station. Also, it is highly desirable to have some personnel with operating room experience to decontaminate patients with traumatic injuries. It is not necessary for the other personnel working in the decontamination station to have any appreciable training or experience other than that given when the medical facility is put into operation.

## DECONTAMINATION

Early removal of radioactive "contamination" will reduce radiation burns, radiation dosage, and the chances of inhaling or ingesting radioactive material. There are two rules to be remembered in the removal of radioactive contamination:

1. Removal of radioactive contamination is best accomplished with soap and water.
2. Contamination is easily spread, so "spot" cleaning must be attended to before general decontamination procedures are started.

Cotton swabs or gauze maybe used to decontaminate moist areas, gummed tapes to decontaminate dry areas. If after the first cleansing decontamination is inadequate, the process should be repeated three to five times; then, if contamination persists, the following preparation may be tried:

- A mixture of 50 percent detergent and 50 percent cornmeal with enough water added to make a paste. This should be used with additional water as necessary and the contaminated area scrubbed (preferably with a soft bristle surgical brush) for 5 minutes, then rinsed.

After the hot spots have been removed, the second step is to shower with soap and water. Scrub the entire body, including the hair and nails. After the shower, monitor again; if any contamination remains, again spot clean and shower. If the hair is contaminated, shampoo it several times.

If it becomes apparent that shampooing has not removed the radioactive material, clip the hair as close to the scalp as necessary to remove the radioactive material.

If areas become tender from excessive washing, it may be necessary to restore some of the skin oils by gently rubbing in a small amount of lanolin or ordinary hand or face cream. This will soothe the skin and prepare it for further decontamination if additional steps are necessary. Decontamination should be continued until the radioactivity has been reduced to the "safe" level set by the responsible Medical Department

representative. Wounds or body parts that resist decontamination may have to be covered, and the patient referred to a higher level medical treatment facility.

Protect any uncontaminated cut, scratch, or wound with an impermeable tape or other suitable material while decontaminating the rest of the body. If a wound is already contaminated, the simplest and least drastic decontamination method available should be tried first, always by trained medical personnel. First, the wound should be carefully bathed or flushed with sterile water, and a reasonable amount of bleeding should be encouraged.

Following decontamination, standard triage procedures, described in chapter 4 of the *HM 3 & 2* Rate Training Manual, are used.

Additional information pertaining to the initial management of irradiated or radioactively contaminated individuals may be obtained from the current BUMEDINST 6470.10.

## CONTAMINATED MATERIAL AND SUPPLIES

Radiological material may be removed but not destroyed. Water then becomes a special problem. Water coming from an underground source usually is free from radioactive materials and is therefore usable, but water coming from a reservoir that has to depend upon a surface watershed for its source may not be usable. Fortunately, regular water-treatment processes that include coagulation, sedimentation, and filtration will remove most fallout material, and if the reservoir water can be properly treated, it will be usable again. But for safety's sake, never drink untested water. Distillation frees water of radioactive material providing emergency drinking water.

Supplies and food can be protected from residual radiation by storage in dustproof containers. Although the outside of the containers may become contaminated, most of this radioactive material may be removed by washing. The container can then be opened and the contents removed and used without fear of causing significant contamination.

The outer wrappings on medical supplies and the peelings on fruit and vegetables also afford protection to their contents. After carefully removing the outer coverings and checking the contents, it maybe found that these materials will be safe to use.

Contaminated clothing should be handled with care. It should never be casually placed on furniture, hung on walls, or dropped on floors. Clothing should be stored in garbage cans or disposable containers. If these are not available, it should be placed on pieces of paper large enough to be rolled and secured. Grossly contaminated clothing should be properly disposed of by an authorized method, such as burial at sea or in deep pits or trenches, whichever is appropriate.

If clothing is in short supply, lightly contaminated clothing may be salvaged by special laundering. Three washings in hot water with detergent should be sufficient. To be sure that this procedure has freed the clothing of radioactive material, each article should be monitored before it is released for reuse. Rubber and plastic materials are readily decontaminated in a warm detergent wash.

**REFERENCES:**

1. NAVMED P-5059, *Nato Handbook on the Medical Aspects of NBC Defensive Operations*

2. NAVMED P-5041, *Treatment of Chemical Agent Casualties*